

Regulatory Pathways, Potential Obstacles, and Practical Solutions for CO₂ Geosequestration

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Enhanced Hydrocarbon Recovery

- Nonexperimental near-term CO₂ injection will be primarily for enhanced recovery of oil, gas, and coal bed methane (CBM)
- Some CO₂ geosequestration is a consequence but not the principal purpose of enhanced recovery (ER)
- Enhanced oil and gas recovery operations are regulated as Class II wells under the Underground Injection Control (UIC) program

Legal/Regulatory Issues

- With 30 years of experience, regulation of oil and gas ER is well established under UIC Class II program with known permitting/regulatory requirements
- One key question will be determining whether any different UIC requirements should apply if and when an ER operation becomes an operation solely for CO₂ geosequestration
- Agencies administering the Class II program are well equipped to regulate CO₂ geosequestration

CO₂ Geosequestration

CO₂ Geosequestration for FutureGen

- The FutureGen near zero emission power plant project being funded by DOE may be the first CO₂ geosequestration project of consequence
- FutureGen is purposely focused on conducting CO₂ geosequestration to establish the viability of the technology for CO₂ generated by a coal-fueled power plant
- Accordingly, the siting and permitting of the FutureGen facility will prompt the need to answer additional questions about the authorization and permitting of geosequestration projects

Does UIC Program Apply?

- For straight CO₂ geosequestration, the first legal question is whether any different statutory scheme applies by law, or is it subject to UIC requirements?
- Under the Safe Drinking Water Act (SDWA), the term “underground injection” means the subsurface emplacement of fluids by well injection and **excludes the underground injection of natural gas for purposes of storage.**

SDWA §1421(d)(1)(A)&(B)(i), 42 USC §300h(d)(1) (A)&(B)(i).

Is CO₂ “natural gas”?

- One would think this is a settled issue.
- But the answer is not always the same and depends in large part on regulatory context.
- Sometimes CO₂ is considered natural gas.
- Sometimes it is not considered natural gas.
- Agencies and courts have differed on this.

Carbon Dioxide is:

- A naturally occurring gas
- A component of produced natural gas
- A valuable commodity for many uses, including use in enhanced recovery production operations
- Produced, purified and transported via pipeline, barge, rail and truck in the same way as other natural gasses

CO₂ = Natural Gas?

- Such factors have caused carbon dioxide to be defined as a natural gas under specific circumstances and for specific purposes – notably all related to the use of CO₂ for ER projects
- But will these factors qualify carbon dioxide as a natural gas for purposes of excluding CO₂ injection for storage from regulation under the UIC program?
- Although that precise question has not yet been answered, EPA has previously concluded that even CO₂ from natural sources is not natural gas for other purposes
- A different conclusion, even in altered context, seems unlikely

Natural Gas under the SDWA

- “Apart from simply employing the term “natural gas,” the SDWA does not elaborate on the term's intended meaning or scope.”

ARCO Oil and Gas Company v. EPA, 14 F.3d 1431, 1434 (10th Cir. 1993).

- “[W]e conclude, once again, that ‘the term “natural gas” is ambiguous’ and “fairly and reasonably has more than one meaning.””

ARCO Oil and Gas Company v. EPA, 14 F.3d 1431, 1434 (10th Cir. 1993).

FERC Interpretation

- The term 'natural gas' has two fundamentally different meanings.
- In the terminology of chemistry, 'natural gas ' would mean any gas occurring naturally, including such gases as helium and carbon dioxide.
- The common meaning of 'natural gas,' however, is a mixture of hydrocarbons, each one having a different chemical composition, but each one being volatile or having a certain vapor tension.
- The non-combustible natural gases, such as carbon dioxide, are often produced in combination with combustible gases, and the mixture is often referred to generally as 'natural gas,' without any attempt to distinguish between the combustible and non-combustible gases.

SDWA Natural Gas Exclusion

- The natural gas exclusion was added in 1980
- Only limited references in legislative history
- “[N]ot intended to exempt from regulation underground injection other than gas storage which may be undertaken by gas storage operators”
- “[A]pplies only to natural gas as it is commonly defined, and not to other injections of matter in a gaseous state”

EPA's Regulatory Approach

- EPA had proposed permit by rule for natural gas storage based on the “inherent economic incentive” that “reduces the need for scrutiny of these operations.”
44 Fed. Reg 23738, 23745 (Apr. 20, 1979).
- EPA noted at the time that “the subsurface storage of hydrocarbons is practical only if a preponderant portion of the stored resource can be recovered when desired.”
44 Fed. Reg 23738, 23745 (Apr. 20, 1979).

Does long-term storage qualify?

- Can the same economic case be made for long-term CO₂ storage?
- Do similarly compelling economic incentives (such as credits) apply to containment?
- Final answer likely will be EPA's determination on this issue, which seems unlikely to change
- Agency interpretations have prevailed in Court
- Will determine whether CO₂ storage is under UIC

UIC WELL CLASSIFICATION ISSUE

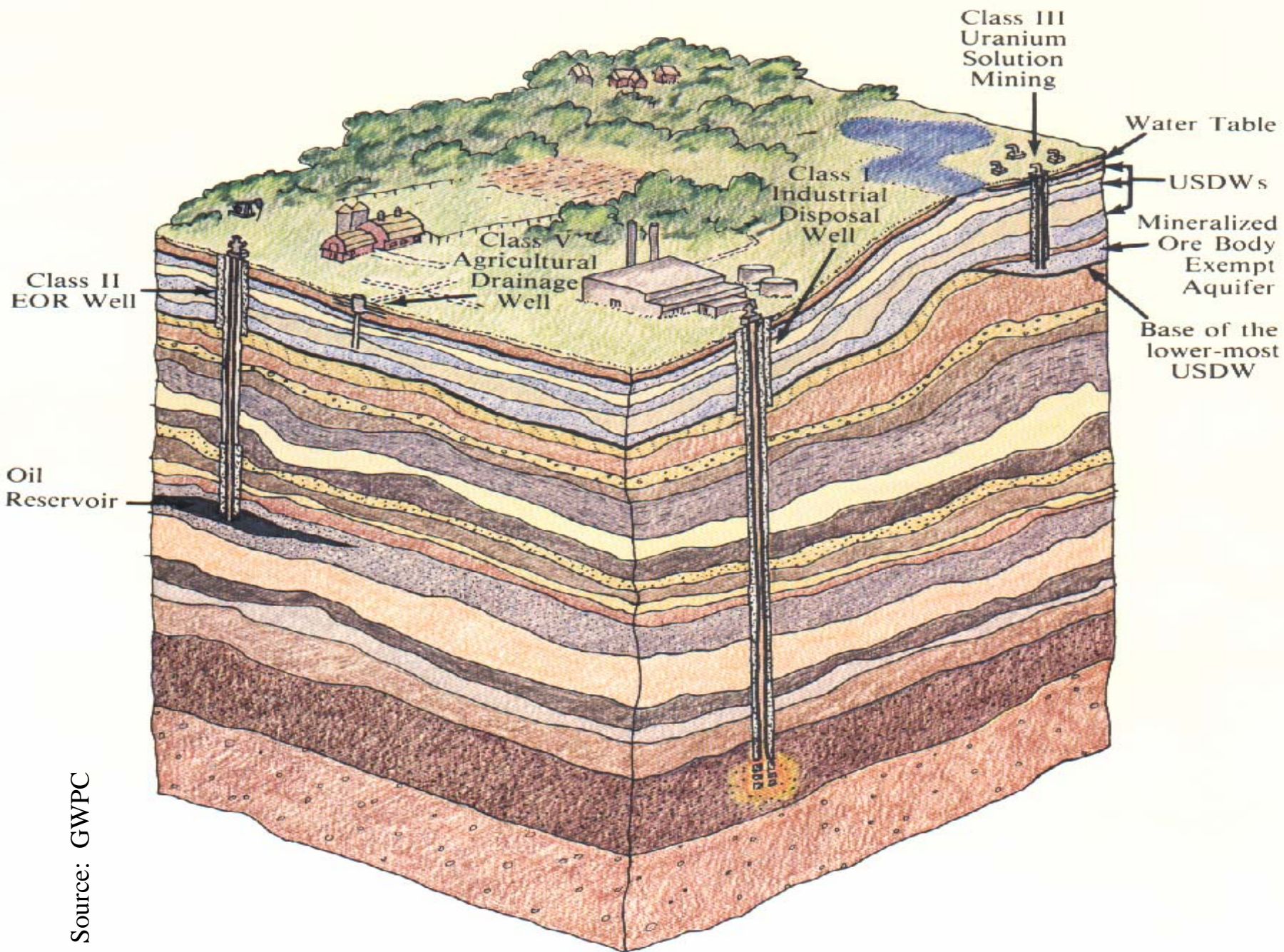
Well Classification Issue

- The well classification issue has centered on 3 choices
- ER wells for oil and gas production already are regulated under Class II
- Some have suggested that CO₂ geosequestration wells should be regulated under Class I as waste disposal wells
- Others have suggested that Class V, which has been used for the pilot project wells, is appropriate

UIC Well Classes

- **Class I wells** are technologically sophisticated and inject hazardous and non-hazardous wastes below the lowermost underground source of drinking water (USDW). Injection occurs into deep, isolated rock formations that are separated from the lowermost USDW by layers of impermeable clay and rock.
- **Class II wells** are oil and gas production brine disposal and other related wells. Operators of these wells inject fluids associated with oil and natural gas production. Most of the injected fluid is brine that is produced when oil and gas are extracted from the earth (about 10 barrels of brine for every barrel of oil).
- **Class III wells** are wells that inject super-heated steam, water, or other fluids into formations in order to extract minerals. The injected fluids are then pumped to the surface and the minerals in solution are extracted. Generally, the fluid is treated and re-injected into the same formation. More than 50 percent of the salt and 80 percent of the uranium extraction in the U.S. is produced this way.
- **Class IV wells** inject hazardous or radioactive wastes into or above underground sources of drinking water. These wells are banned under the UIC program because they directly threaten public health.
- **Class V wells** are injection wells that are not included in the other classes. Some Class V wells are technologically advanced wastewater disposal systems used by industry, but most are "low-tech" wells, such as septic systems and cesspools. Generally, they are shallow and depend upon gravity to drain or "inject" liquid waste into the ground above or into underground sources of drinking water. Their simple construction provides little or no protection against possible ground water contamination, so it is important to control what goes into them.

Source: <http://www.epa.gov/safewater/uic/classes.html>



Source: GWPC

Fluid Movement Restrictions

Fluid Movement Issues

- Will Class I and II applicants be subjected to an absolute prohibition on any movement of injected CO₂ into any underground source of drinking water (USDW)?
- EPA's view on this issue has changed over time but currently appears to favor an interpretation of its own rules that would impose an absolute prohibition on such movement for **Class I, II, and III wells** even while acknowledging that the SDWA does not itself impose such a prohibition.
- SDWA prohibits injection that endangers USDWs

SDWA Does Not Impose an Absolute Prohibition

“Underground injection endangers drinking water sources if such injection may result in the presence in underground water which supplies or can reasonably be expected to supply any public water system of any contaminant, and if the presence of such contaminant may result in such system’s not complying with any national primary drinking water regulation or may otherwise adversely affect the health of persons.”

SDWA § 1421(d)(2); 42 U.S.C. § 300h(d)(2).

Competing Interpretation

- The UIC regulations are susceptible to an alternative interpretation that was advanced in a challenge to the Florida UIC program.
- EPA acceptance of an absolute fluid movement prohibition was embodied in a settlement agreement prepared among EPA, Florida DEP, and the Legal Environmental Assistance Foundation (LEAF) as a basis for revising the Florida UIC program rules.

Settlement Rejected

- This Florida settlement was never fully implemented
- Instead, Florida DEP sought to drop the absolute fluid movement prohibition, but LEAF refused to do so
- Litigation resumed with the settlement abandoned
- The reviewing US Court of Appeals for the 11th Circuit upheld the Florida rule without any explicit fluid movement prohibition
- Nevertheless, some continue to argue UIC Class I, II, and III rules impose an absolute prohibition

Recent EPA Statements

- EPA appeared to reiterate the absolute prohibition interpretation most recently when it promulgated new permitting requirements for municipal injection wells in Florida where some movement of injected fluids outside the injection zone has been documented without necessarily endangering a USDW.
- EPA adopted new requirements to allow movement that does not constitute endangerment if the well operators meet specified pretreatment requirements.
- In adopting this rule, EPA again acknowledged that the SDWA itself does not impose an absolute prohibition. It is only EPA's regulations that do, and only for Class I, II, and III wells (now excluding municipal wells).

Fluid Movement Restrictions

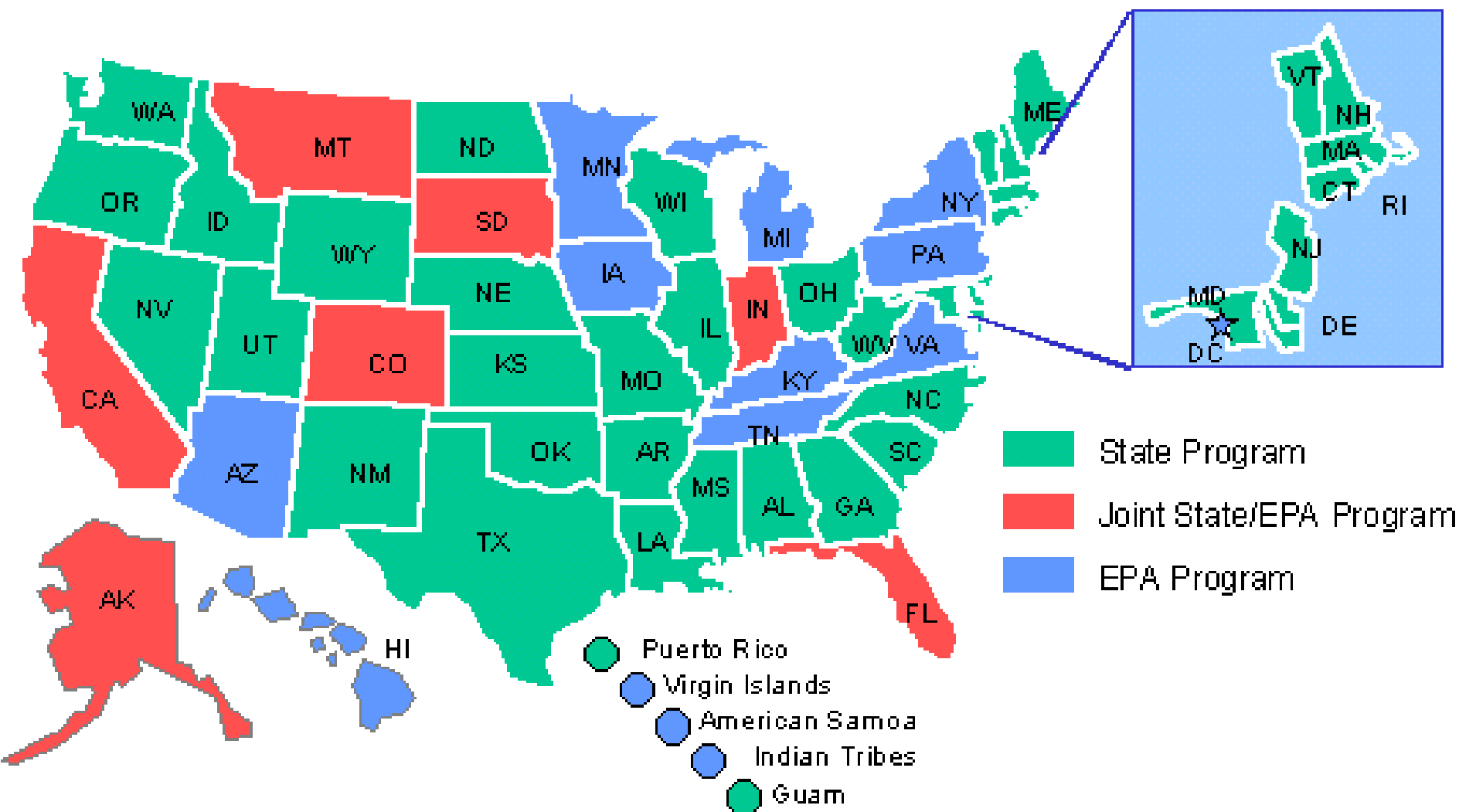
- Disagreement continues over whether or not EPA's current rules impose an absolute prohibition on movement of injected fluids and/or constituents into USDWs.
- Nevertheless, EPA has acknowledged flexibility to fashion regulations for CO₂ geosequestration that do not impose an absolute fluid movement prohibition
- **Using Class V permitting or a new class could avoid undue application of absolute prohibition**

UIC Permitting for Geosequestration

Dual Permitting?

- Transforming ER projects into CO₂ geosequestration projects would potentially require repermitting Class II wells as Class I or V wells under current UIC program
- Projects designed to transition could address this up front through dual permitting, but that might require dealing with 2 different agencies and 2 different levels (state and federal)
- Stacked injection could pose these same issues
- Split agency permitting is problematic and avoidable

UIC Primacy Delegation



Class Conflict Avoidance

- Dual permitting for ER wells could be avoided by retaining such wells in Class II even after transition to geosequestration of CO₂
- Dual permitting could also be avoided by providing for continuing jurisdiction over such wells by the initial permitting agency notwithstanding a separate classification such as Class V (e.g., CA DOGGR regulation of Class V geothermal injection wells)

UIC WELL CLASSIFICATION ISSUE

What Well Classification?

- Clearly Enhanced Recovery wells are regulated as Class II wells under the UIC program as “Wells which inject fluids: (2) For enhanced recovery of oil or natural gas;” 40 CFR §146.5(b)(2).
- Pilot project wells have been authorized under Class V as “(15) Injection wells used in experimental technologies.” 40 CFR §146.5(e)(15).
- Some say full scale GS project wells should be regulated as Class I wells. This issue remains open.

Should Geosequestration Wells be Class I?

(a) Class I.

- (1) Wells used by generators of hazardous waste or
- (2) Other industrial and municipal **disposal wells** which inject fluids beneath the lowermost formation containing, within one quarter mile of the well bore, an underground source of drinking water.

40 C.F.R. §146.5(a)

Disposal Wells

“Disposal well” means a well used for the disposal of waste into a subsurface stratum.

40 C.F.R. §146.3 (Definitions)

CO₂ is not defined as a waste

- Carbon dioxide used for enhanced recovery is not a waste being disposed.
- At this juncture, carbon dioxide has not been classified as a waste when injected for geological sequestration.
- Carbon dioxide is not a regulated pollutant under the Clean Air Act or any other statutory scheme.

Class V Regulation

- To date CO₂ pilot projects have been permitted under Class V as “[w]ells used in experimental technologies” 40 CFR §146.5(e)(15)
- Carbon dioxide is not classified as a UIC waste
- Accordingly, regulation of CO₂ injection for geological sequestration under Class V might be fully justified
- During the early stages of geosequestration authorization, Class V regulation could provide appropriate flexibility to adapt authorization by permit to the specifics of geosequestration projects.

Class V Regulation

- 40 CFR §144.79 General: This subpart tells you what requirements apply if you own or operate a Class V injection well. You may also be required to follow additional requirements listed in the rest of this part.
- “[Y]ou cannot allow movement of fluid into USDWs that might cause endangerment,
- “[Y]ou must comply with other Federal UIC requirements in 40 CFR parts 144 through 147, and
- “[Y]ou must comply with any other measures required by your State or EPA Regional Office UIC Program to protect USDWs, and
- “[Y]ou must properly close your well when you are through using it.”

40 C.F.R. § § 144.79 & 144.82.

Fluid Movement Requirement

40 CFR 144.82(a) Prohibition of fluid movement.

- (1) As described in Sec. 144.12(a), your injection activity cannot allow the movement of fluid containing any contaminant into USDWs, if the presence of that contaminant may cause a violation of the primary drinking water standards under 40 CFR part 141, other health based standards, or may otherwise adversely affect the health of persons. This prohibition applies to your well construction, operation, maintenance, conversion, plugging, closure, or any other injection activity.
- (2) If the Director of the UIC Program in your State or EPA Region learns that your injection activity may endanger USDWs, he or she may require you to close your well, **require you to get a permit**, or require other actions listed in Sec. 144.12(c), (d), or (e).

Other Requirements

- 40 CFR parts 144 through 147 define minimum Federal UIC requirements.
- EPA Regional Offices administering the UIC Program have the flexibility to establish additional or more stringent requirements based on the authorities in parts 144 through 147, if believed to be necessary to protect USDWs.
- States can have their own authorities to establish additional or more stringent requirements if needed to protect USDWs.
- Class V well operators must comply with any reasonable additional requirements once established.

Inventory Information

- Class V well operators must give the UIC Program Director certain information about the injection operation.
- Class V well operators must submit at least the following information for each Class V well: facility name and location; name and address of legal contact; ownership of facility; nature and type of injection well(s); and operating status of injection well(s).

Inventory Information (2)

Class V operators in DI states must provide a list of all wells owned or operated along with the following information for each well.

- (A) Location of each well or project given by Township, Range, Section, and Quarter-Section, or by latitude and longitude to the nearest second, according to the conventional practice in your State;
- (B) Date of completion of each well;
- (C) Identification and depth of the underground formation(s) into which each well is injecting;
- (D) Total depth of each well;
- (E) Construction narrative and schematic (both plan view and cross- sectional drawings);
- (F) Nature of the injected fluids;
- (G) Average and maximum injection pressure at the wellhead;
- (H) Average and maximum injection rate; and
- (I) Date of the last inspection.

Inventory Information (3)

Class V operators in one of the DI states may be required “to **submit other information** believed necessary to protect underground sources of drinking water” including:

- (i) Perform ground water monitoring and periodically submit your monitoring results;
- (ii) Analyze the fluids you inject and periodically submit the results of your analyses;
- (iii) Describe the geologic layers through which and into which you are injecting; and
- (iv) Conduct other analyses and submit other information, if needed to protect underground sources of drinking water.

Requirement of Permit

- With certain exceptions listed in the regulations, Class V injection activity is “authorized by rule,” meaning operators have to comply with all the requirements and the rest of the UIC Program but you don't have to get an individual permit.
- Failure to comply with the prohibition of fluid movement standard in Sec. 144.12(a) and described in Sec. 144.82(a) will negate the authorization by rule and require the operator to get a permit, close the well, and/or comply with other conditions determined by the UIC Program Director;
- The UIC Program Director for a state also has some discretion to require a Class V operator to get a permit.

CRITICAL REGULATORY CONSIDERATIONS

Research vs. Regulation

- Detailed scientific assessments and measurement, monitoring, and verification have multiple functions
- The first function is for project proponents and regulatory officials to determine that the technology is safe and effective when properly applied
- The second function is to determine circumstances for proper application
- The third is to determine what steps are necessary to ensure continuation of proper application and safety

Words of Caution

It will be much more difficult and essential to work out what we do not need to do – otherwise the task will overwhelm us.

Peter Cook – 20 March 2006

4 Stage Demonstration

1. Demonstrate safety and efficacy of underground injection technology for CO₂ geosequestration
2. Determine what minimum criteria will ensure safe and effective siting of projects – set standards
3. Geosequestration siting demonstration for a specific projects – meet standards
4. Project monitoring and reporting – verification and maintenance of standards

Technology Demonstration

- The measurement and monitoring work carried out over the past 5 years has been extremely useful in showing the viability of geosequestration
- The questions of how much measurement and monitoring is necessary to demonstrate the acceptability of geosequestration project sites and satisfactory operation and maintenance are different
- Broad imposition of unwarranted requirements, however technically feasible at a cost, could stifle application of CO₂ geosequestration and realization of achievable benefits

Conclusions

- Broad deployment of a safe and effective CO₂ geosequestration technology is the objective
- Avoiding burdensome and unnecessary siting and demonstration requirements will advance objective
- Avoiding regulatory restrictions designed for entirely different applications of technology will also help
- Retaining regulatory flexibility and fostering application of experience and expertise in the early stages should prove particularly beneficial as well

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